Physics 102 Spring 2007: Suggested Problems # 3

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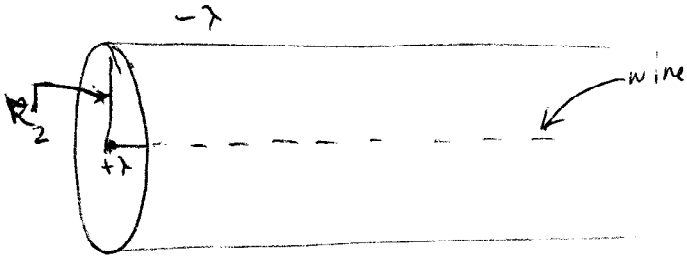
1. Problem 23-28. (**+10 pts**)

   i. +6 pts - correct electric field (magnitude) for $R_1 < r < R_2$.
      a. +2 pts - electric flux ($\Phi_E = \frac{\lambda l}{\varepsilon_0}$).
      b. +4 pts - electric flux ($\oint_S \vec{\mathbf{E}} \cdot d\vec{\mathbf{A}} = E\, 2\,\pi\, r\, l$)
   ii. +2 pts - correct magnitude of electric field at R_1 ($E = 3.1 \times 10^8$ N/C).
   iii. +2 pts - correct magnitude of electric field at R_2 ($E = 5.1 \times 10^5$ N/C).

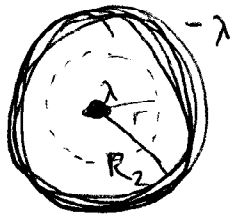
23-28

Side View



$R_2 = 3\,cm$

Front View



wire has radius $= \frac{0.10}{2}\,mm = R_1$

$E(R_1 < r < R_2) = ?$ Draw a Gaussian cylinder with $r < R_2$ but $r > R_1$, and length l about the center of the cylinder.

$$\Phi = \frac{Q_{enc}}{\varepsilon_0} = \frac{\lambda l}{\varepsilon_0}$$

$$\Phi = \oint \vec{E}\, d\vec{A} = \oint E\, dA = E \oint dA = E \cdot 2\pi r l$$

$\vec{E} \parallel d\vec{A}$; E constant over surface; surface area of cylinder

$$\Rightarrow \boxed{E(R_1 < r < R_2) = \frac{\lambda}{2\pi\varepsilon_0 r}} \quad \text{with } \lambda \text{ carried over thin wire}$$

and $\boxed{E(r = R_1) = \frac{\lambda}{2\pi\varepsilon_0 R_1}} = 3.1 \times 10^8\ N/C$

and $\boxed{E(r = R_2) = \frac{\lambda}{2\pi\varepsilon_0 R_2}} = 5.1 \times 10^5\ N/C$

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